Space Weather Technical Forecast

Issued on Friday, 02 September 2022 at 01:29 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of M-class flares (R1-R2 Blackouts). G1/Minor Geomagnetic Storm expected on day 3 (4th Sep).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity was Low, with no significant flare activity. AR3089 (Eai/βγδ) remains the largest and most complex region on the visible disc, with the highest probability of producing significant flares, but appears to be stable despite a recent slight increase in area. There are also two new regions, plus two other numbered sunspot regions on the visible disc: AR3091 in the northwest and AR3092 which rotated onto the southeast limb. These regions are all relatively small, magnetically simple and appear stable. No new coronal mass ejections (CMEs) have been observed from available imagery, despite a small filament eruption early afternoon from the eastern hemisphere.

Solar Wind / Geomagnetic Activity: Solar winds were predominantly elevated, roughly between 500 to 580 km/s due to high speed stream (HSS) related to coronal hole 17. The solar wind peaked at 601 km/s at 01/0553 UTC, but declined later in the day to become slightly elevated around 480 km/s. Density was above average. Total interplanetary magnetic field strength was initially moderate at 8 nT but quickly decreased to become weak, The north-south component, Bz, was occasionally negative early in the day, reaching -6nT at 01/0120 UTC, but quickly settled to become mainly neutral or positive. The Phi angle was negative (towards the Sun) throughout. Geomagnetic activity was Quiet to Unsettled (Kp1-3).

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV), as measured by GOES-16, is at background levels. The high energy electron flux (greater than 2 MeV) was at background to moderate levels. The 24-hour integrated electron fluence remained well below the Active threshold (1e8 integrated pfu) with 2.02e6 integrated pfu observed at 02/0000 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Activity is Low. There is a chance, however, of isolated M-class flares, mainly from AR3089, with a slight chance of X-class flares. However, a new region may rotate onto the northeast limb within the next couple of days, potentially increasing the probabilities of a significant flare.

Solar Wind / Geomagnetic Activity: Solar winds are expected to continue to gradually decline today (2nd September). Solar wind speed increases are expected early day 2, or more likely early day 3 (4th) due to the connection with two consecutive high speed streams. In addition a marked filament eruption observed on 30 August produced a CME which may give a glancing blow at Earth, most likely later tomorrow (3rd September), however confidence is low regarding this.

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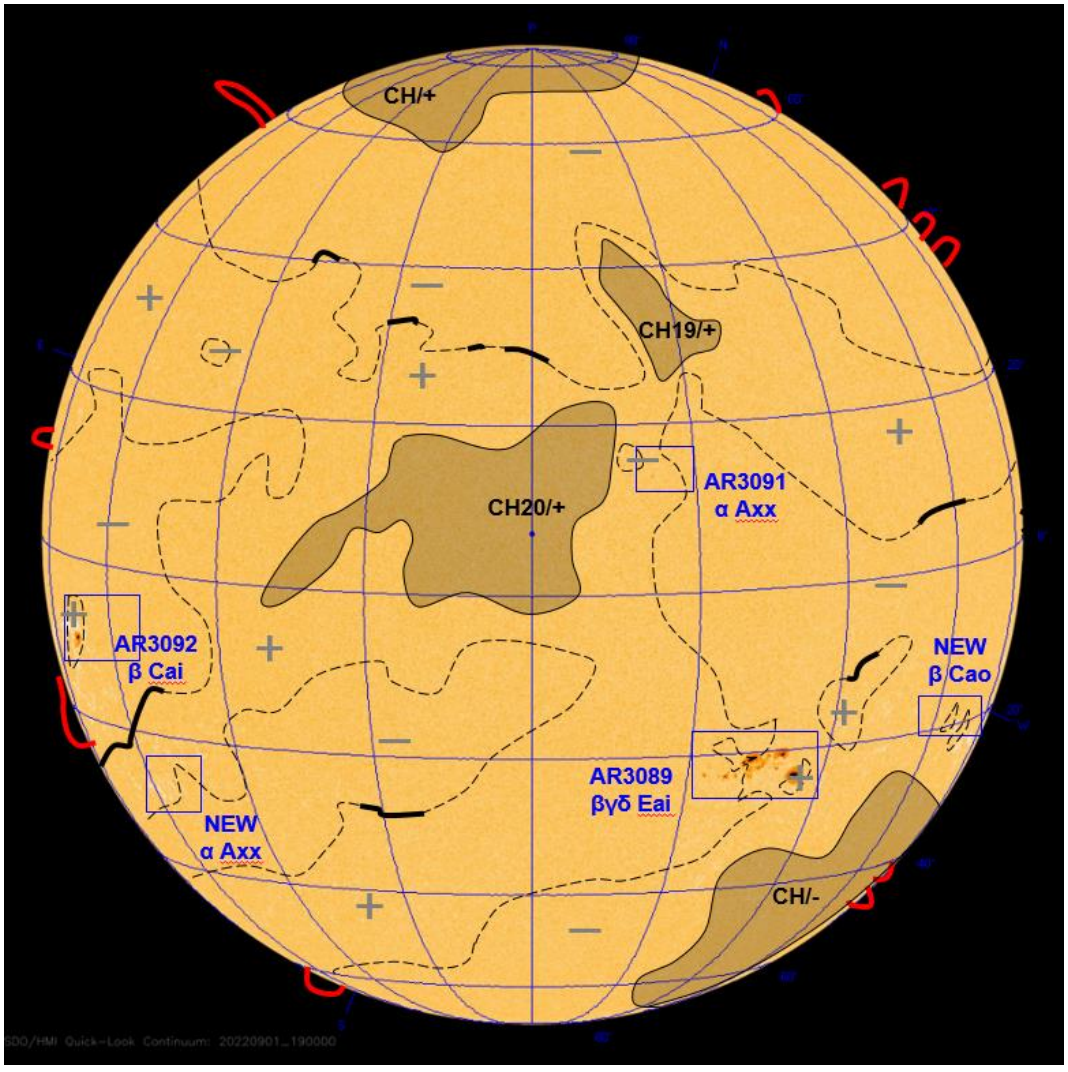
Geomagnetic activity is expected to be Quiet (Kp 0-2) today, with perhaps an isolated Unsettled (Kp 3) interval. Geomagnetic activity is then expected to be Quiet to Unsettled (Kp 2-3) tomorrow, increasing day 3 (4th) to become Unsettled to G1/Minor Storm (Kp 3-5), with an isolated G2/Moderate storm interval (Kp 6) likely, as a result of a substantial coronal hole high speed stream arriving from CH20 and any preceding CIR (co-rotating interaction region).

Energetic Particles / Solar Radiation: High energy protons (greater than 10 MeV) are expected to remain below S1/Minor radiation storm levels, but with a slight chance of reaching S1 or above should any significant flares occur from AR3089. The high energy (greater than 2 MeV) electron flux is expected to be mostly at moderate levels today, tomorrow and also day 4, perhaps briefly reaching high levels at the peak of the diurnal cycle. In-between for days 2 and 3 (3rd and 4th) background to moderate levels are expected. The corresponding 24 hour fluence levels are likely to remain below the Active threshold, with a rising trend later in the period.

Figure 1. Solar Analysis Valid 01/1900 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

Solar winds are expected to continue to gradually decline today (2nd September). Solar wind speed increases are expected early day 2, or more likely early day 3 (4th) due to the connection with initially CH19 and then CH20. Both of these features are positive, and the autumn equinox is approaching. Also, CH20 appears larger and stronger compared to the previous rotation, when wind speeds reached around 580 km/s at times and a G1/Minor geomagnetic storm occurred. Therefore the HSS from these features are expected to have a slightly stronger impact. In addition a marked filament eruption observed on 30 August produced a CME which may give a glancing blow at Earth, most likely later tomorrow (3rd September), however confidence is low regarding this.

Geomagnetic activity is expected to be Quiet (Kp 0-2) today, with perhaps an isolated Unsettled (Kp 3) interval. Geomagnetic activity is then expected to be Quiet to Unsettled (Kp 2-3) tomorrow, increasing day 3 (4th) to become Unsettled to G1/Minor Storm (Kp 3-5), with an isolated G2/Moderate storm interval (Kp 6) likely, as a result of a substantial coronal hole high speed stream arriving from CH20 and any preceding CIR (co-rotating interaction region).

Geo-Magnetic Storm	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Minor or Moderate	G1 to G2	No	1	20	80	40
Strong	G3	No	1	1	10	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
31/0204	Partial	Filament	SE quadrant	420 km/s	03/1800UTC	Limited shock – glancing blow.

Figure 2: SDO AIA 193 imagery. Previous rotation left, recent image right, with CH20 centre disc.

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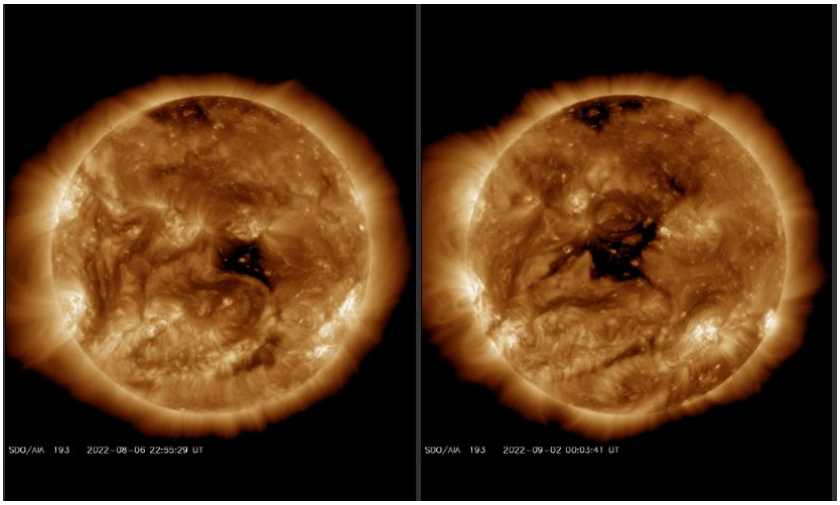
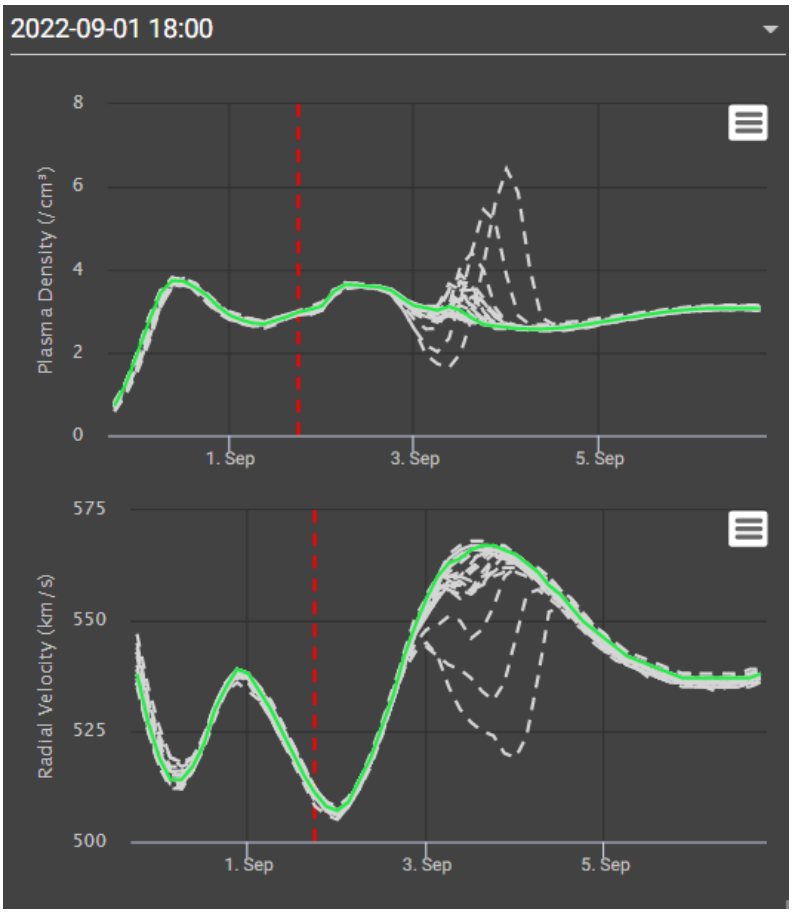


Figure 3: ENLIL Ensemble forecasts showing the potential CME arrive.



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Radio Blackouts - X-Ray Flares:

Solar activity has been Low over the last 24 hours with no M-class flares observed. The most significant active region is currently AR3089 (Eai/Beta-Gamma-Delta), which is large, but has produced limited solar activity, with relatively organised magnetic looping. This provides the greatest flare risk though, with a chance (20-30%) of M-class flares and a slight chance (5%) of X-class flaring. The remaining regions on the visible side of the solar disc are currently not considered to present a notable risk.
Looping on the eastern limb suggests a potential increase in activity, with further active regions possibly rotating onto the Earth-facing disc. These will continued to be monitored for an increasing risk.

X Ray Flares / Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 M Class	No	30	30	30	30
Very Active	R3 to R5 X Class	No	5	5	5	5

Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10MeV) remains at background values. AR3089 (Eai/Beta-Gamma-Delta despite apparent stability, continues to present a slight chance of a proton event at Earth should there be any significant flaring. This risk will continue as the region rotates further across the southwestern quadrant.

Radiation Storms / Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ S1	No	5	5	5	5
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

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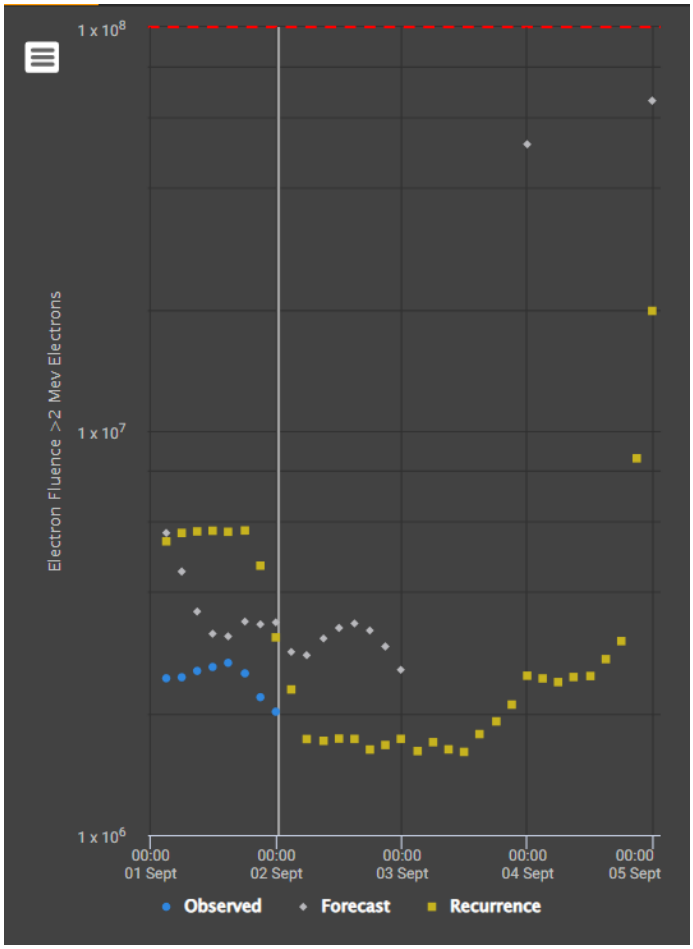
High energy electron flux (greater than 2MeV) may exceed the high (1e3 pfu) threshold today, tomorrow and day 4 (5th) as solar winds decline and radiation belts relax into their natural orbits. However, elevated solar winds from high speed streams and potential periods of heightened geomagnetic activity are expected to inhibit the electron flux during day 3 (4th).
The corresponding 24 hour fluence levels are likely to remain below the Active threshold, with a rising trend later in the period. Therefore the REFM model is considered to be offering good guidance.

GEO Electron Environment	Level ($cm^{-2}\ sr^{-1}\ day^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^8$	No	5	20	10	40
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

Figure 4: Met Office REFM model



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